

1044.04

Industrial Exposure and Control Technologies for OSHA Regulated Hazardous Substances



U.S. Department of Labor
Elizabeth Dole, Secretary
March 1989

Volume I of II
Substances A-I

Occupational Safety and Health Administration
John A. Pendergrass, Assistant Secretary

Carbon monoxide
(CAS NUMBER: 630-08-0)

SYNONYMS

Carbon oxide /Carbone (oxyde de) (French)/Carbonic oxide/
Carbonio (ossido di) (Italian)/Exhaust gas/Flue gas/
Kohlenmonoxid (German)/Kohlenoxyd (German)/Koolmonoxyde (Dutch)/
Oxyde de carbone (French) /Wegla tlenek (Polish)

TRADE NAMES

NONE

DESCRIPTION OF SUBSTANCE

Carbon monoxide is a colorless, odorless compressed gas or compressed liquified gas. The liquid floats and boils on water. It is sparingly soluble in water (3.3 ml/100 ml of water at 0 degrees C). [ACGIH, P. 106, 1986]

HEALTH EFFECTS

Carbon monoxide combines with hemoglobin which interferes with the oxygen-carrying capacity of blood, resulting in a state of tissue hypoxia [SITTIG, P. 191, 1985]
Symptomatology: 1. No symptoms or shortness of breath during vigorous muscular exercise (0 to 10% COHB (carboxyhemoglobin)). 2. A mild headache and breathlessness on moderate exercise (10-20% COHB). 3. Throbbing headache, irritability, emotional instability, impaired judgment, defective memory, and rapid fatigue (20-3-% COHB). 4. Severe headache, weakness, nausea and vomiting, dizziness, dimness of vision, confusion (30-40% COHB). 5. Hallucinations, severe ataxia, accelerated respirations (40-50% COHB). 6. Syncope or coma with intermittent convulsions, tachycardia with a weak pulse (50-60% COHB), pallor or cyanosis. 7. Increasing depth of coma with incontinence of urine and feces (60-70% COHB). 8. Profound coma with depressed or absent reflexes, a weak thready pulse, shallow and irregular respirations and complete quiescence (70-80% COHB). 9. Rapid death from respiratory arrest (above 80% COHB). 10. Miscellaneous and atypical reactions include various skin lesions, sweating, hepatomegaly, hyperpyrexia, albuminuria, oliguria, anginal pain, and congestive heart failure. 11. During convalescence a bronchopneumonia may develop because of the aspiration of saliva or vomitus 12. Myocardial infarction, with or without coronary thrombosis, may appear at any time up to one week following an acute poisoning. 13. After an uneventful convalescence, signs of nerve or brain injury may appear at any time within three weeks following an acute exposure. Among permanent sequelae are neuropathies, various motor and mental defects, some of which mimic multiple sclerosis or parkinsonism, and death. [GOSSELIN. CTCP 4TH ED 1976]

Severe carbon monoxide poisoning can produce skin lesions varying from areas of erythema and edema to marked blister and bulla formation. Pathological lesions that occur in brain, heart, skin and other organs are primarily vascular and they consist of small hemorrhages and perivascular infiltration with focal necrosis. [GOODMAN. PHARM BASIS THERAPP 6TH ED, 1980] Prolonged posthypoxic unconsciousness may damage vital organs severely. In man, histological studies of brain have shown extensive demyelination of white matter, bilateral necrosis of globus pallidus, and necrotic lesions of amon's horn. [GOODMAN. PHARM BASIS THERAP 6TH ED 1980]

Infants born to women who have survived acute exposure to a high concentration of the gas often display neurological sequelae and there may be gross damage to brain. Persistent low levels of carboxyhemoglobin in fetus of woman who smokes may also reduce infant's mental abilities. [GOODMAN. PHARM BASIS THERAP 6TH ED 1980]

Nine of 10 patients with severe carbon monoxide poisoning exhibited 1 or more of following abnormal ECG changes: sinus tachycardia, t-wave abnormalities, s-t segment depression and atrial fibrillation. Evidence of ischemic changes and subendocardial infarction also observed. [GOODMAN. PHARM BASIS THERAP 6TH ED 1980]

Visual disturbances; i.e., (a) amaurosis or hemianopsia, (b) constriction of visual fields, and (c) visual abnormalities associated with optic nerve disturbances result as a consequence of acute poisoning in which there has been period of unconsciousness [GRANT. TOX OF THE EYE 1974]

A carbon monoxide-intoxicated patient developed increased permeability-type pulmonary edema demonstrated by a normal capillary wedge pressure and production of protein-rich edema fluid. [FEIN A ET AL; CARBON MONOXIDE EFFECT ON ALVEOLAR EPITHELIAL PER MEABILITY; CHEST 78(5) 726 (1980)]

Patient with possible residual neurologic effects from carbon monoxide and retrospective study of pediatric patients with acute diagnosis of carbon monoxide poisoning are presented. Evidence for conclusion that carbon monoxide can produce residual neurological injury is included. [BINDER JW, ROBERTS RJ; CARBON MONOXIDE INTOXICATION IN CHILDREN; CLIN TOXICOL 16(3) 287 (1980)]

TOXICITY/EXPOSURE LIMITS

NFPA RATING - Flammability	- 4	Extreme
Health	- 2	Moderate
Reactivity	- 0	None

TOXICITY HAZARD RATING - Acute and chronic local: skin 3; mucous membranes 3; eyes 3. Acute and chronic systemic; ingestion 3; inhalation 3; skin 3. 3=High: may cause death or permanent injury after exposure to small quantities. [SAX. DANGER PROPS INDUS MATER 6TH ED, P. 643, 1984]

IMMEDIATELY DANGEROUS TO LIFE OR HEALTH - 1500 ppm [ENCYC
OCCUPAT HEALTH &
SAFETY 1983]

OSHA PEL - 35.000 ppm, 40.000 mg/m³;TWA
200.000 ppm, 229.000 mg/m³;Ceiling
200.000 ppm, 229.000 mg/m³;Ceiling

ADOPTED ACGIH/TLV - 50.000 ppm, 55.000 mg/m³;TWA
400.000 ppm, 440.000 mg/m³;STEL

NIOSH/REL - 35.000 ppm, ***** mg/m³;TWA
200.000 ppm, ***** mg/m³;STEL - no minimum
time

INDUSTRY USE DATA

Carbon monoxide is used as a reducing agent in metallurgical operations; Fischer-Tropsch processes for petroleum-type products; manufacture of metal carbonyls. [MERCK INDEX. 10TH ED, 1983]

In manufacture of zinc white pigments. [HAWLEY. CONDENSED CHEM
DICTIONARY 9TH ED 1977]

Unisolated component of gaseous fuels-e.g., water gas; chemical intermediate for phosgene, methanol, acetic acid, acrylic acid, synthetic fuels (non-U.S. use), dimethylformamide, oxo alcohols via aldehydes (e.g., butyl alcohol), methyl formate, alkyl carbonates and silicon carbide fibers; comonomer in ethylene-carbon monoxide copolymer; reducing agent in iron ore processing; purification agent for nickel via nickel carbonyl; chemical intermediate for other metal carbonyls-e.g., tungsten carbonyl; chemical intermediate for ethylene glycol (former use). [SRI]

NIOSH 1982 NATIONAL OCCUPATIONAL EXPOSURE SURVEY

SIC CODE	INDUSTRY NAME	TOTAL ON PAYROLL	TOTAL EXPOSED	PERCENT EXPOSED
2895	CARBON BLACK	42	18	42.86
4212	LOCAL TRUCKING/W/O STORAGE	3,498	321	9.18
3291	ABRASIVE PRODUCTS	568	36	6.34

NIOSH 1972 NATIONAL OCCUPATIONAL HAZARD SURVEY

SIC CODE	INDUSTRY NAME	TOTAL ON PAYROLL	TOTAL EXPOSED	PERCENT EXPOSED
3313	ELECTROMETALLURGICAL PRODUCTS	147	43	29.25
3433	HEATING EQUIPMENT, EXCEPT ELE	1,355	202	14.91

2782	BLANKBOOKS AND LOOSELEAF BIND	8	1	12.50
3399	PRIMARY METAL PRODUCTS, NEC	230	26	11.30
2816	INORGANIC PIGMENTS	708	55	7.77
2298	CORDAGE AND TWINE	430	30	6.98

OSHA/EXPOSURE DATA

NONE

ENGINEERING CONTROLS

General ventilation; local exhaust ventilation; hood; enclosure of process or worker. These are methods for reduction of carbon monoxide exposure to fork lift operators in a bottling plant. Company operation was propane powered lift trucks replaced with electric trucks. [HAZARD ABATEMENT FILE]

These are methods for fume, dust and gas control from arc furnace melting of iron. Company operation was iron foundry; melting using arc furnaces; operators performed the following duties: clean scrap from cover seal area, measure temperature and sample melt, operate furnace controls and shovelling refractory material into furnace. A hood was designed such that the far furnace electrode was exhausted by hood extensions passing around the near electrode. The hood was constructed of 5/16 inch type 309 stainless steel. All corner joints were replaced with overlap joints. Exhausts were filtered through cloth filters before release to outside. [HAZARD ABATEMENT FILE]

These are methods for reducing carbon monoxide levels in a fork lift operation. Company operation was forklift operation. Switched fuel supply to LP gas and installed louvers and exhaust fan. [HAZARD ABATEMENT FILE]

These are methods for proper maintenance controls on carbon monoxide output of propane powered equipment. Company operation was knitting mill; use of propane powered fork lift trucks in a warehouse. Proper maintenance of propane powered fork lift trucks resulted in reduction of carbon monoxide in exhaust from 4.5% to 0.05%. [HAZARD ABATEMENT FILE]

These are methods for engineering controls for carbon monoxide exposure in an automotive engine reconditioning line. Company operation was automotive engine testing; rebuilt engines are run on a test stand to make adjustments. Exhaust fans and flexible ducts extending directly over the engines were installed. [HAZARD ABATEMENT FILE]

These are methods for carbon monoxide exhaust gas control for LPG-powered industrial trucks. Company operation was commercial printing; LPG-powered industrial trucks, Caterpillar t-508, white towmotor. Installed Engine Vent Systems, manufactured by Engine Ventilation Systems, Inc., Elk Grove, IL. This crankcase ventilator takes crankcase fumes and blow-by and filters; then returns for re-burn in combustion chamber. Exhaust CO reduced from 5% to less than 1%. Room concentrations of CO dropped from 160 ppm to less than 5 ppm. Cost available from Engine Ventilation Systems. [HAZARD ABATEMENT FILE]

PERSONAL PROTECTIVE EQUIPMENT

Personal safety precautions: wear self-contained breathing apparatus, safety glasses and safety shoes. Also rubber overclothing including gloves. Respiratory protection should be as follows: Up to 350 ppm: any supplied-air respirator or self-contained breathing apparatus. Up to 875 ppm: any supplied-air respirator operated in a continuous flow mode. Up to 1500 ppm: any self-contained breathing apparatus with a full facepiece or any supplied-air respirator with a full facepiece; or any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted canister providing protection against the compound of concern. Emergency or planned entry in unknown concentration or IDLH conditions: any self-contained breathing apparatus with full facepiece and operated in a pressure-demand or other positive pressure mode or any supplied-air respirator with a full facepiece and operated in pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus and operated in pressure-demand or other positive pressure mode. Escape: any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted canister providing protection against the compound of concern or any appropriate escape-type self-contained breathing apparatus. [NIOSH: POCKET GUIDE TO CHEMICAL HAZARDS P. 73 (1987) DHEW (NIOSH) PUB NO. 85-114]

STORAGE

Protect containers against sunlight and store in well-ventilated, safe areas. Remove all sources of ignition. Electric installation should be of explosion-proof construction. [ITII, P. 108, 1986]